



US005966286A

United States Patent [19]

O'Connor et al.

[11] Patent Number: 5,966,286

[45] Date of Patent: Oct. 12, 1999

[54] COOLING SYSTEM FOR THIN PROFILE
ELECTRONIC AND COMPUTER DEVICES

[75] Inventors: **Michael O'Connor**, Cupertino; **Kevin Haley**; **Rakesh Bhatia**, both of San Jose; **Daniel Thomas Adams**, Menlo Park; **Michael Andrew Kast**, Palo Alto, all of Calif.

[73] Assignee: **Intel Corporation**, Santa Clara, Calif.

[21] Appl. No.: **08/658,856**

[22] Filed: **May 31, 1996**

[51] Int. Cl.⁶ **H05K 7/20**

[52] U.S. Cl. **361/699**; 165/80.3; 165/104.33;
361/687; 438/106

[58] Field of Search 165/80.3, 104.33,
165/80.4, 185, 104.21-104.26, 104.29;
257/712, 713; 174/15.2, 16.3; 62/259.2;
364/708.1; 29/832, 841, 854, 729, 739,
740; 361/687, 694-703, 701, 717-719;
437/209, 221, 222; 438/106, 118, 584,
675

[56] References Cited

U.S. PATENT DOCUMENTS

4,595,338	6/1986	Kolm et al.	416/81
4,706,739	11/1987	Noren	165/104.14
4,780,062	10/1988	Yamada	417/322
5,008,582	4/1991	Tanuma	310/332
5,089,935	2/1992	Ito	361/383

5,267,122	11/1993	Glover et al.	361/704
5,339,214	8/1994	Nelson	361/695
5,383,340	1/1995	Larson	62/259.2
5,430,609	7/1995	Kikinis	361/687
5,494,098	2/1996	Morosas	165/121
5,513,070	4/1996	Xie et al.	361/700
5,598,320	1/1997	Toedtman	361/687
5,615,084	3/1997	Anderson	165/80.3
5,646,824	7/1997	Ohashi et al.	361/704

FOREIGN PATENT DOCUMENTS

572326A2	5/1993	European Pat. Off.	165/80.3
451994	10/1993	Japan	
5-259673	10/1993	Japan	

Primary Examiner—Gerald Tolin

Attorney, Agent, or Firm—Blakely, Sokoloff, Taylor & Zafman LLP

[57] ABSTRACT

An apparatus and method for removing heat from a heat generating component located within a thin-profile consumer electronic or computer system enclosure is disclosed. In one embodiment the cooling system of the present invention includes an air duct comprising a thermally conductive housing having internal fins dispersed along the internal walls of the duct. An air flow generator produces an air flow that is directed from an inlet port located at or near the center of the air duct to first and second exit ports located at opposite ends of the duct. A low resistance thermal path, such as a heat pipe, transfers heat from the heat generating component to the air duct housing.

19 Claims, 9 Drawing Sheets

